

REMARKS

I. Introduction

By the present Amendment, claims 1 and 17 have been amended. Claim 10 has been cancelled. Accordingly, claims 1-3, 5-9, and 11-20 remain pending in the application. Claims 1 and 17 are independent.

II. Interview Summary

Applicants would like to thank Examiners Bohr and Winakur for the courtesy and cooperation extended during the interview conducted on October 14, 2009. During the interview, Applicants discussed the patentable features of the invention with respect to independent claim 1. In particular, Applicants indicated that the present invention includes a luminance/hue color bar which indicates the speed and variance of blood flow in a region of the blood vessel. Additionally, the present invention provides a transparency color bar that can be used to indicate the variance of the blood flow. The image processing means would cause the Doppler image to be displayed transparently based on the degree of transparency selected by the transparency control means and one or both color bars that have been selected by the selection means. The Examiner indicated that these features were not clearly described in the claims, and that there did not appear to be a relationship between the image processing means and the color bar selected by the selection means. The Examiner suggested that the claims be amended to better indicate the relationship between these two elements.

III. Office Action Summary

In the Office Action of June 23, 2009, claim 10 was objected to under 37 CFR §1.75(c) as being of improper dependent form. Claims 1-3 and 5-20 were rejected under 35 USC §103(a) as being unpatentable over U.S. Patent No. 7,044,913 issued to Shiki et al. ("Shiki") in view of U.S. Patent No. 6,116,244 issued to Hossack et al. ("Hossack"), in view of U.S. Patent No. 6,239,796 issued to Alexander et al. ("Alexander"). This rejection is respectfully traversed.

IV. Objections to the Claims

Claim 10 was objected to under 37 CFR §1.75(c) as being of improper dependent form for failing to further limit the subject matter of the previous claim. Regarding this objection, the Office Action indicates that the claim recites the limitation "display the transparency color bar of which transparency is varied depending on a variance." The Office Action indicates that this limitation does not appear to further limit the subject matter of claim 1.

By the present Amendment, Applicants have cancelled claim 10, thereby rendering this particular objection moot.

V. Rejection under 35 USC §103

Claims 1-3 and 5-20 were rejected under 35 USC §103(a) as being unpatentable over Shiki in view of Hossack, and further in view of Alexander. Regarding this rejection, the Office Action indicates that the grounds of rejection set forth in the previous Office Action were being maintained. Specifically, it had been previously indicated that Shiki discloses an ultrasound apparatus for forming a tomogram of an examinee by transmitting/receiving an ultrasound wave via an ultrasound probe. Shiki was further indicated as disclosing a color Doppler image

forming means, image processing means for both the tomogram and the Doppler image, and a display to display the images. Hossack was relied upon for disclosing control of the degree of the transparency of the color Doppler image based on blood flow information or variance of the blood flow. Alexander was relied upon for disclosing display of either only the selected dialog box or the original with the selected dialog boxes.

By the present Amendment, Applicants have amended independent claim 1 to better define the invention with respect to features that are not shown or suggested by the art of record. As amended, independent claim 1 defines an ultrasound diagnostic apparatus that comprises:

a tomogram forming means for forming a tomogram of a diagnosis portion of an examinee by transmitting/receiving an ultrasound wave to/from the examinee via an ultrasound probe;

color Doppler image forming means for forming a color Doppler image based on a Doppler signal obtained from the diagnosis portion;

a transparency control means for controlling a degree of the transparency of the color Doppler image;

selection means for selecting one or both of a luminance/hue color bar, which is based on the information of a velocity and/or variance of a blood flow, and/or a transparency color bar, which is based on the information of the variance, for alternatively or simultaneously displaying the luminance/hue color bar and/or the transparency color bar on the display means;

image processing means for performing image processing on the tomogram and the color Doppler image; and

display means for displaying images obtained by the image processing means, the tomogram and the color Doppler image being color displayed on the display means,

wherein the image processing means causes the color Doppler image to be displayed transparently, based on the degree of transparency selected by the transparency control means and one or both color bars selected by the selection means.

The ultrasound diagnostic apparatus of independent claim 1 includes a tomogram forming means for forming a tomogram of a diagnosis portion of an examinee by transmitting/receiving an ultrasound wave to/from the examinee via an ultrasound probe. A color Doppler image forming means is provided for forming a color Doppler image based on a Doppler signal obtained from the diagnosis portion, and a transparency control means is provided for controlling the degree of transparency of the color Doppler image. A selection means is provided for selecting one or both of a luminance/hue color bar, which is based on the information of a velocity and/or variance of blood flow, and/or a transparency color bar which is based on the information of the variance, for alternately or simultaneously displaying the luminance/hue color bar and/or the transparency color bar on the display means. The apparatus also includes an image processing means for performing image processing on the tomogram in the color Doppler image, and display means for displaying images obtained by the image processing means, the tomogram, and the color Doppler image displayed on the display screen. According to independent claim 1, the image processing means causes the color Doppler image to be displayed transparently based on the degree of transparency selected by the transparency control means and one or both color bars selected by the selection means.

As discussed during the interview, color information of the three-dimensional voxel is based on the speed and variance using a luminance/hue color bar. Accordingly, the speed, reflection intensity, and variance are considered for each point on the three-dimensional voxels. See paragraph [0027] and Fig. 5 of the published application. Additionally, the transparency of each point on the three-dimensional voxel is decided based on the variance. See paragraph [0028]. Thus,

according to independent claim 1, the either or both a luminance/hue color bar and/or transparency color bar can be simultaneously or alternatively displayed with a color Doppler image. The luminance/hue color bar is based on information corresponding to both the velocity and variance of blood flow, while the transparency color bar is based on information corresponding to the variance of blood flow. Furthermore, the present invention allows an operator to quickly and easily assess the velocity and variance of blood flow at desired locations by simply referencing the luminance/hue color bar. For example, the operator can view a display such as that shown in Fig. 6(b) and visually determine whether turbulent flow exists in the blood vessel. See paragraph [0032]. In contrast, conventional methodologies (Fig. 6a)) would not provide such visual indications. The operator can further evaluate the turbulence in the blood flow by referencing the transparency color bars.

Contrary to the present invention, the cited references, taken alone or in combination, do not disclose such features. Shiki discloses an ultrasonic diagnosis apparatus that includes an ultrasound probe, a transmitter, a receiver, a CFM processor, a tomographic image processor, and a display unit. Shiki scans a desired section by transmitting and receiving an ultrasound pulse to and from the subject, and displays images obtained by the scanning. A corrector is provided to correct the velocities of the moving element based on the standard velocity. The corrected velocity data can be subsequently visualized on display unit. While Shiki discloses color bars, they are based on either the velocity or power of the blood flow. Corrected velocities are calculated and a color bar is displayed showing the amplitudes of the corrected velocities. See col. 19, lines 39-44 and Fig. 9(a). Shiki is completely silent on displaying either or both a luminance/hue color bar based on

the information of the velocity and variance of blood flow and/or a transparency color bar based on the variance.

Hossack discloses a method and system for generating three-dimensional representations using opacity modulation. The opacity levels are controlled as a function of a Doppler parameter. Thus, some of the data is rendered more opaque than others. Based on this difference in opacity, it is possible to emphasize areas of clinical interest, such as a leak in a heart valve or other areas associated with high variance or velocity jets, on the display. Alexander discloses a signal measurement system which includes an operating system and a graphical user interface. A dialog box control system is provided to manage display and interactivity with respect to a selected one of a plurality of dialog boxes to be opened on the graphical user interface in accordance with a selected one of a plurality of dialog launch modalities. Hossack and Alexander are also completely silent on displaying either or both a luminance/hue color bar based on the information of the velocity and variance of blood flow and/or a transparency color bar based on the variance. The cited references simply fail to provide any disclosure or suggestion for features recited in independent claim 1, such as:

selection means for selecting one or both of a luminance/hue color bar, which is based on the information of a velocity and/or variance of a blood flow, and/or a transparency color bar, which is based on the information of the variance, for alternatively or simultaneously displaying the luminance/hue color bar and/or the transparency color bar on the display means;

image processing means for performing image processing on the tomogram and the color Doppler image; and

display means for displaying images obtained by the image processing means, the tomogram and the color Doppler image being color displayed on the display means,

wherein the image processing means causes the color Doppler image to be displayed transparently, based on the degree of

transparency selected by the transparency control means and one or both color bars selected by the selection means.

It is therefore respectfully submitted that independent claim 1 is allowable over the art of record.

Claims 2, 3, 5-8, 10-16, 19, and 20 depend from independent claim 1, and are therefore believed allowable for at least the reasons set forth above with respect to independent claim 1. In addition, these claims each introduce novel elements that independently render them patentable over the art of record.

As amended, independent claim 17 defines an ultrasound diagnosing method that comprises the steps:

a transmitting/receiving step for transmitting/receiving an ultrasound wave to/from an examinee via an ultrasound probe;

a forming step for forming a tomogram of a diagnosis portion of the examinee;

an imaging step for forming a color Doppler image based on a Doppler signal obtained from the diagnosis portion;

a step of selecting one or both of a luminance/hue color bar, which is based on the information of a velocity and variance of a blood flow, and/or a transparency color bar, which is based on the information of the variance, for alternatively or simultaneously displaying the luminance/hue color bar and/or the transparent color bar on the display means;

an image processing step for performing image processing on the tomogram and the color Doppler image based on the result of the selecting step;

a first display step for displaying the images which underwent the image processing so as to display the tomogram and the color Doppler image in color display; and

a second display step for displaying the color Doppler image transparently which includes a control step for controlling a degree of the transparency of the color Doppler image of the transparent display.

The ultrasound diagnosis method of independent claim 17 recites various steps that are somewhat similar to those recited in independent claim 1. In particular, the method includes a step of selecting one or both of a luminance/hue color bar and/or a transparency bar such that the luminance/hue color bar and the transparent color bar can be displayed either simultaneously or alternatively on a display means. The luminance/hue color bar is based on information corresponding to the velocity and variance of blood flow, while the transparency color bar is based on information corresponding to the variance of blood flow. Furthermore, an image processing step is performed on the tomogram and Doppler image based on the result of the selection step. As previously discussed with respect to independent claim 1, the art of record fails to provide any disclosure or suggestion for such features.

It is therefore respectfully submitted that independent claim 17 is allowable over the art of record.

Claim 18 depends from independent claim 17, and is therefore believed allowable for at least the reasons set forth above with respect to independent claim 17. In addition, this claim introduces novel elements that independently render it patentable over the art of record.

VI. Conclusion

For the reasons stated above, it is respectfully submitted that all of the pending claims are now in condition for allowance. Therefore, the issuance of a Notice of Allowance is believed in order, and courteously solicited.

If the Examiner believes that there are any matters which can be resolved by way of either a personal or telephone interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

AUTHORIZATION

Applicants request any shortage or excess in fees in connection with the filing of this paper, including extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case: 529.45793X00).

Respectfully submitted,
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